HUMAN FACTORS/PERSONNEL VIEWS - AGENDA

• Background

• Views
  – Taxonomy
  – Structure
  – Connectivity
  – Processes
  – States
  – Interaction
  – Constraints
  – Roadmap
  – Traceability

• Conclusion
THE UNIFIED ARCHITECTURE FRAMEWORK (UAF)

IDEAS based

UML profile based

MODAF v1.2.004

MODEM

NAF v4.0

DoDAF 2.02 change 1

DNDAF

Other influences...

IDEAS brings a high degree of formality to the domain meta-model
WHY A UNIFIED ARCHITECTURE FRAMEWORK

• Proliferation of frameworks that UPDM was being asked to support

• Need to support industry and federal usage as well as military
  – Commercialization, whilst still supporting Warfighter needs

• Ability to support other frameworks
  – By Extension
  – By Mapping

• IDEAS based format for DMM Allows implementation by non-SysML based tools
  – Same format as DoDAF 2.02
<table>
<thead>
<tr>
<th>Taxonomy</th>
<th>Structure</th>
<th>Connectivity</th>
<th>Processes</th>
<th>States</th>
<th>Interaction Scenarios</th>
<th>Information</th>
<th>Parameters</th>
<th>Constraints</th>
<th>Roadmap</th>
<th>Traceability</th>
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Dictionary * Dc
Summary & Overview SmOv
Requirements Rq
WHY THE GRID?

• Demilitarizes UPDM
  • Still the same underlying metamodel and view constructs that support:
    • DoDAF
    • MODAF
    • NAF
  • Different presentation layers
• Very hard to manage the views with so many contributing frameworks
  • Lead to very complex mapping tables
  • Unwieldy descriptions

• Possible to map many other frameworks onto the MM
  • HSI views and SoS views
**Stakeholders:** Human resources, Solution Providers, PMs.

**Concerns:** human factors.

**Definition:** aims to clarify the role of Human Factors (HF) when creating architectures in order to facilitate both Human Factors Integration (HFI) and systems engineering (SE).

Based on Human Factors work done at the MOD/NATO

Dr Anne Bruseberg was one of the principal authors

Informed by a MODAF/Human Factors gap analysis that found that 95% of human factors views elements were already in MODAF
HV-A: Personnel Availability
HV-B: Quality Objectives and Metrics
HV-C: Human Interaction Structure
HV-D: Organisation
HV-E: Human Functions and Tasks
HV-F: Roles and Competencies
HV-G: Dynamic Drivers of Human Behaviour

OV-1a,b
OV-1c
OV-2
OV-3
OV-4
OV-5
OV-6
OV-7
OV-8
OV-9
OV-10
StV-2
StV-3,5
StV-4
Formal Dependencies
Part-whole
Rank
Conditions
Operational Configurations/States
1...n

Human Functions/Tasks
Operational Configurations/States 1...n
HV-A HV-G
HV-E HV-C
HV-D HV-B

Facilities Systems
Information access, transmission and sharing
Enable Affect

Roles/Responsibilities
Formal Task-Based Organisation
Defined through
Part-whole Rank

Taskwork (decomposition)
HV-F

Competency Requirements
Skills Attributes Knowledge

Personnel Development
Person (through Post) in Role
Needs Ensures Have status of

Actual People
People availability
Trends/Forecasts
Numbers Characteristics

Display
Dynamic properties

Operational Configurations/States

HV-A HV-G
HV-E HV-C
HV-D HV-B

Environmental Constraints
Actual virtual

HFI Value Level 1...n

Time/Epoch
Assessed through
Target Measures

Human Performance Criteria & Metrics
Methods of Compliance
Detailed through
HFI Value definitions Level 1...n
THE “YACHT IN DISTRESS” SCENARIO

• The Sample Problem applies UPDM to a common scenario in civilian maritime Search and Rescue (SAR) operations -- a Yacht in distress. A Monitor Unit picks up the Distress Signal from the Yacht and passes it on to the Command and Control (C2 Center). The C2 Center coordinates the search and rescue operation among the Rescue Helicopter, a Naval Ship and a Rescue Boat.

• This model is based on a UK MOD example model.
Pr-Tx Personnel Taxonomy

The Pr-Tx view specifies the taxonomy of types of organizational resources.

- **Stakeholders:** Human resources, Solution Providers, PMs.
- **Concerns:** organizational resource types.
- **Definition:** shows the taxonomy of types of organizational resources.
- **Recommended Implementation:** SysML Block Definition Diagram.
PR-TX PERSONNEL TAXONOMY
Pr-Sr Personnel Structure Specification

- **Stakeholders**: Human resources, Solution Providers, PMs.
- **Concerns**: typical organizational structure used to support a capability(ies).
- **Definition**: shows organizational structures and possible interactions between organizational resources.
- **Recommended Implementation**: SysML Block Definition Diagram, SysML Internal Block Diagram.
PR-SR PERSONNEL STRUCTURE SPECIFICATION
Pr-Cn Personnel Connectivity Specification

- **Stakeholders**: Solution providers.
- **Concerns**: interaction of organizational resources.
- **Definition**: captures the possible interactions between organizational resources, including command relationships. Interactions typically illustrate the fundamental roles and management responsibilities.
- **Recommended Implementation**: tabular format.
PR-CN PERSONNEL CONNECTIVITY SPECIFICATION
<table>
<thead>
<tr>
<th>Resource</th>
<th>Conveyed</th>
<th>Producer</th>
<th>Function</th>
<th>Connector / Protocol</th>
<th>Consumer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>boatInstruction</td>
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<tr>
<td></td>
<td>aircraftInstruction</td>
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<tr>
<td></td>
<td>radioInstruction</td>
<td></td>
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<tr>
<td></td>
<td>lifePreserverInstruction</td>
<td></td>
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</tr>
<tr>
<td>BCI</td>
<td>«Exchange Element»</td>
<td>«Post»</td>
<td>MRT Searcher</td>
<td>Resource Connector</td>
<td>«_resource Artifact» Lighting Device</td>
</tr>
<tr>
<td></td>
<td>beaconInstruction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Stakeholders: Systems engineers, Solution providers.

Concerns: functions that have to be carried out by organizational resources.

Definition: specifies organizational resource functions in relation to resource definitions.

Recommended Implementation: SysML Activity Diagram, SysML Block Definition Diagram, BPMN Process Diagram
PR-PR PERSONNEL PROCESSES SPECIFICATION
Rescue Victim

- Move
- Determine Destination
- Transport
- Reassure Victim
- Apply First Aid
- Recover Victim

Objects:
- location
- destination
- reportedLocation
- victimName
- condition
- updatedCondition
- updatedLocation

Actions:
- Determine Destination
- Transport
- Reassure Victim
- Apply First Aid
- Recover Victim

Relationships:
- «Function»
- «CapabilityConfidentiality»
- «Maritime Rescue Unit v1»

Notations:
- «Function»
- «CapabilityConfidentiality»
- «Maritime Rescue Unit v1»

Attributes:
- name
- reportedCondition
- updatedCondition
- updatedLocation
Pr-St Personnel States Specification

• **Stakeholders**: Systems Engineers, Software Engineers.

• **Concerns**: capture state-based behavior of an organizational resource.

• **Definition**: it is a graphical representation of states of an organizational resource and how that organizational resource responds to various events and actions.

• **Recommended Implementation**: SysML State Diagram.
PR-ST PERSONNEL STATES SPECIFICATION

Maritime Rescue Team Phase 3

- Waiting for Mission
  - do : Mission Training
  - do : Sleep
  - do : Eat
  - do : Maintain Equipment

- Planning Mission
  - do : Determine Destination

- Team Preparation
  - Board Rescue Vessel

- Searching for Person in Distress
  - do : Move
  - do : Search

- Person in Distress Found
  - do : Apply First Aid
  - do : Recover Victim
  - do : Reassure Victim
  - do : Transport

- Post Mission Processing
  - do : Unload Equipment
  - do : Debrief

- Returning to Base
  - do : Move

- Arrive at Base

- Distress Beacon

- Route Info

- Search Cancelled

- Distressed Party Rescued

- Distressed Party Found

- Area Of Interest Update Ph2 / Determine Destination
• **Stakeholders**: Software Engineers, Systems Engineers.

• **Concerns**: interactions between organizational resources (roles).

• **Definition**: provides a time-ordered examination of the interactions between organizational resources.

• **Recommended Implementation**: SysML Sequence Diagram, BPMN Collaboration Diagram.
PR-IS PERSONNEL INTERACTION SCENARIO SPECIFICATION
PR-IS PERSONNEL INTERACTION SCENARIO SPECIFICATION

SAR Organization Context Phase 3

Description:

- Distress Signal Sent
- Operator Informs Manager
  - Operator provides track info
- SAR Manager requests Assistance
- Military C2 Manager Tasks Pilot
  - Pilot Updates Status
- Military updates SAR C2
  - Operator tasks Rescue Team
    - Operator Updates Track info
      - Communicator Tasks Searcher
        - Searcher Updates Status
          - Communicator Updates Operator

- Exchange: distressSignal
- Command: emergencyNotification
- Command: trackInfo
- Command: request
- Command: update
- Command: status
- Command: radionInstruction
- Command: control
- Command: trackInfo
- Command: status
- Command: status
- Command: status
Pr-Cta Personnel Constraints Specification (Competencies to Posts)

- **Stakeholders**: Systems engineers, Solution providers.
- **Concerns**: allocation of competencies to actual posts.
- **Definition**: specifies requirements for actual organizational resources – by linking competencies and actual posts.
- **Recommended Implementation**: SysML Block Definition Diagram.
PR-CTA PERSONNEL CONSTRAINTS SPECIFICATION (COMPETENCIES TO POSTS)
### Definitions and Requires Competence

#### Pr-Cta [Architectural Description] Personnel Competencies

|--------|------------------|--------|-------------|--------|----------------------|--------|--------------|--------|----------------|--------|----------------|--------|----------------|

- **MRT Communicator**
  - Requires Competence: Communicate Effectively
  - Resource Role: Communicate Status

- **MRT Swimmer**
  - Requires Competence: Render First Aid
  - Resource Role: Save Lives

- **MRT Helicopter Pilot**
  - Requires Competence: Navigation
  - Resource Role: Air Transit

- **MRT Searcher**
  - Requires Competence: Good Vision
  - Resource Role: Find Victim

- **MRT Boat Driver**
  - Requires Competence: Marine Awareness
  - Resource Role: Sea Rescue

- **Soa Responsible**
  - Requires Competence: Coordination
  - Resource Role: Status Update

- **SAR C2 manager**
  - Requires Competence: Manage Teams
  - Resource Role: Allocate Resources
Roles and Actuals for Provides Competence

- Lifeboat Driver
- Rescue Helo Pilot
- C2 chief
- Rescue swimmers
- Senior swimmers
- Radio operators
- Drivers
- Pilots
- Searchers

Competencies:

- Communicate Effectively
- Render First Aid
- Navigation
- Good Vision
- Marine Awareness
- Coordination
- Manage Teams

Pr-Cta Personnel Constraints Specification (Competencies to Posts)
Pr-Ctb Personnel Constraints Specification (Drivers)

- **Stakeholders:** Systems engineers, Solution providers, Human resources.
- **Concerns:** optimization of organizational resource behavior.
- **Definition:** captures the factors that affect, constrain and characterize organizational resource behavior as the basis for performance predictions at the level of actual persons and actual organizations. It creates a bridge between static architectural definitions and behavior predictions through executable models.
- **Recommended Implementation:** tabular format, SysML Parametric Diagram, SysML Block Definition Diagram.
PR-CTB PERSONNEL CONSTRAINTS SPECIFICATION (DRIVERS)
Conditions

- LightCondition: Darkness
- LightCondition: Low Light
- LightCondition: Low Clouds
- LightCondition: Bright Sunlight
- Environment: Artic Water
- Environment: Temperate Water
- Environment: Cold Water
- Condition: High Seas
- Condition: Calm Sea
- Condition: Medium Waves
- GeoPoliticalExtentType: Ocean
- GeoPoliticalExtentTypeKind: GeoFeatureType
- requiredEnvironment: Cold Water
- requiredEnvironment: Temperate Water
- requiredEnvironment: Artic Water
Definition of metrics for reuse throughout the architecture.
AV-3 ACTUAL MEASUREMENTS

<table>
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<th>Actual Property Set</th>
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<tr>
<td>seaConditions : Sea State = Sea State 8</td>
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<tr>
<td>areaCoverage : Coverage = 600</td>
</tr>
<tr>
<td>findTime : Elapsed Time = &lt;5 hours</td>
</tr>
<tr>
<td>persistence : Elapsed Time = &gt;20 hours</td>
</tr>
<tr>
<td>searchCoverage : Coverage = 500</td>
</tr>
<tr>
<td>weatherConditions : Weather Conditions = Stormy</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Measurement Values</th>
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<tbody>
<tr>
<td>seaConditions : Sea State = Sea State 8</td>
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<tr>
<td>areaCoverage : Coverage = 650</td>
</tr>
<tr>
<td>findTime : Elapsed Time = &lt;4 hours</td>
</tr>
<tr>
<td>persistence : Elapsed Time = &gt;20 hours</td>
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<tr>
<td>searchCoverage : Coverage = 550</td>
</tr>
<tr>
<td>weatherConditions : Weather Conditions = Stormy</td>
</tr>
</tbody>
</table>

**Initial Values : Maritime SAR Measurements**
- seaConditions : Sea State = Sea State 6
- areaCoverage : Coverage = 500
- findTime : Elapsed Time = <8 hours
- persistence : Elapsed Time = >15 hours
- searchCoverage : Coverage = 400
- weatherConditions : Weather Conditions = Heavy Rain

**Required Values : Maritime SAR Measurements**
- seaConditions : Sea State = Sea State 8
- areaCoverage : Coverage = 600
- findTime : Elapsed Time = <5 hours
- persistence : Elapsed Time = >20 hours
- searchCoverage : Coverage = 500
- weatherConditions : Weather Conditions = Stormy

**Final Values : Maritime SAR Measurements**
- seaConditions : Sea State = Sea State 8
- areaCoverage : Coverage = 650
- findTime : Elapsed Time = <4 hours
- persistence : Elapsed Time = >20 hours
- searchCoverage : Coverage = 550
- weatherConditions : Weather Conditions = Stormy

**UPDM : Standard SAR Measurements**

<table>
<thead>
<tr>
<th>intention</th>
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</thead>
<tbody>
<tr>
<td>Estimate</td>
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</tbody>
</table>

| areaCoverage : Coverage = 10 |
| findTime : Elapsed Time = 20 |
| persistence : Elapsed Time = 50 |
| searchCoverage : Coverage = 60 |
| weatherConditions : Weather Conditions = 70 |
Properties and Constraints (Rules)

**propertySet**
- «Condition» Calm Sea
- «Condition» High Seas
- «Condition» Medium Waves
- «Environment» Artic Water
- «Environment» Cold Water
- «Environment» Temperate Water
- «GeoPoliticalExtentType» Ocean
- «LightCondition» Bright Sunlight
- «LightCondition» Darkness
- «LightCondition» Low Clouds
- «LightCondition» Low Light

**ResourceConstraint**
(Search personnel shall operate on a shift system to ensure that they can perform to maximum efficiency)

**actualPropertySet**
- «ActualMeasureSet» Final Values: Maritime SAR Measurements

**Post**
- MRT Searcher
  - «Performs» «Function» Reassure Victim
  - «Performs» «Function» Recover Victim

**activityPerformableUnderCondition**
- «Environment» Artic Water
- «Environment» Cold Water
- «Environment» Temperate Water
Pr-Ctc Personnel Constraints Specification
(Performance/ Quality Objectives)

- **Stakeholders:** Human resources, solution providers.
- **Concerns:** how well an actual organizational resource matches the needs of the actual organization.
- **Definition:** provides a repository for human-related measures (i.e. quality objectives and performance criteria (HFI values)), targets and competences.
- **Recommended Implementation:** SysML Block Definition Diagram.
PR-CTC PERSONNEL CONSTRAINTS SPECIFICATION (PERFORMANCE/ QUALITY OBJECTIVES)
**Pr-Ctc [Architectural Description] Drivers [Performance]**

**desiredState**
- «OperationalAtomicState» DeliverDistressedPartyToSafePlace
- «OperationalAtomicState» DistressedPartyFound
- «OperationalAtomicState» StayingAsLongAsPossible

**actualPropertySet**
- «ActualMeasureSet» Final Values: Maritime SAR Measurements
- «ActualMeasureSet» Initial Values: Maritime SAR Measurements
- «ActualMeasureSet» Required Values: Maritime SAR Measurements
Pr-Rma Personnel Roadmap Specification (Availability)

• **Stakeholders**: Human Resources, Training, Logisticians, Solution Providers.

• **Concerns**: the staffing and training of resources.

• **Definition**: defines the requirements and functions to ensure that actual persons with the right competencies, and in the right numbers, are available to fulfill actual posts.

• **Recommended Implementation**: Timeline, SysML Block Definition Diagram
Definition

**Pr-Rm** [Architectural Description] Actual Organizations [Availability]

- **Lifeboat Driver**: MRT Boat Driver
- **Radio Operator**: MRT Communicator
- **Rescue Helo Pilot**: MRT Helicopter Pilot

- **Danny Driver**: Qualified Lifeboat Driver
- **Ron Radio**: Marine Radio Operator
- **Peter Pilot**: Qualified Helo Pilot

**(startDate)**: 2010-01-01 00:00:00
**(endDate)**: 2014-01-01 00:00:00
## Architectural Description: Actual Organizations [Availability Table]

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</table>
Pr-Rmb Personnel Availability Specification (Evolution)

• **Stakeholders:** Human resources, Solution Providers.

• **Concerns:** organizational structure changes over time.

• **Definition:** provides an overview of how an organizational structure changes over time. It shows the structure of several organizational structures mapped against a timeline.

• **Recommended Implementation:** timeline, SysML Block Definition Diagram, SysML Internal Block Diagram.
PR-RMB PERSONNEL AVAILABILITY SPECIFICATION (EVOLUTION)
PR-RMB PERSONNEL AVAILABILITY SPECIFICATION (EVOLUTION)

Organizations

Pr-Tx [Architectural Description] Forecast [Phase 1]

«Post» MRT Helicopter Pilot
«Post» MRT Swimmer
«Post» MRT Boat Driver

Pr-Tx [Architectural Description] Forecast [Phase 2]

«Post» MRT Communicator
«Post» MRT Swimmer
«Post» MRT Boat Driver

Pr-Tx [Architectural Description] Forecast [Phase 3]

«Post» SAR C2 Operator
«Post» Soa Responsible
«Post» Military C2 Manager

«ResourceRole» Maritime Rescue Team Phase 1
«ResourceRole» Maritime Rescue Team Phase 2
«ResourceRole» Maritime Rescue Team Phase 3
PR-RMB PERSONNEL AVAILABILITY SPECIFICATION (EVOLUTION)

**ActualProject**

**Org Phase 1 : Development**
- **startDate**: 2014-01-01 00:00:00
- **endDate**: 2015-12-15 00:00:00

**IncrementMilestone**
- **date**: 2014-01-01 00:00:00
- **resource**: SAR Organization Context Phase 1
- **Phase 1 Available : Development Milestone**

**OutOfServiceMilestone**
- **date**: 2015-12-15 00:00:00
- **resource**: SAR Organization Context Phase 1
- **Phase 1 OOS : Development Milestone**

**NoLongerUsedMilestone**
- **date**: 2015-12-15 00:00:00
- **resource**: SAR Organization Context Phase 1
- **Phase 1 NLU : Development Milestone**

**Org Phase 2 : Development**
- **startDate**: 2015-12-16 00:00:00
- **endDate**: 2018-12-31 00:00:00

**IncrementMilestone**
- **date**: 2015-12-16 00:00:00
- **resource**: SAR Organization Context Phase 2
- **Phase 1 Available : Development Milestone**

**OutOfServiceMilestone**
- **date**: 2018-12-31 00:00:00
- **resource**: SAR Organization Context Phase 2
- **Phase 1 OOS : Development Milestone**

**NoLongerUsedMilestone**
- **date**: 2018-12-31 00:00:00
- **resource**: SAR Organization Context Phase 2
- **Phase 1 NLU : Development Milestone**

**Org Phase 3 : Development**
- **startDate**: 2019-12-31 00:00:00
- **endDate**: 2022-12-31 00:00:00

**IncrementMilestone**
- **date**: 2019-01-01 00:00:00
- **resource**: SAR Organization Context Phase 3
- **Phase 1 Available : Development Milestone**

**OutOfServiceMilestone**
- **date**: 2022-12-31 00:00:00
- **resource**: SAR Organization Context Phase 3
- **Phase 1 OOS : Development Milestone**

**NoLongerUsedMilestone**
- **date**: 2022-12-31 00:00:00
- **resource**: SAR Organization Context Phase 3
- **Phase 1 NLU : Development Milestone**
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Pr-Rmc Personnel Roadmap Forecast Specification

• **Stakeholders:** Human resources, Logisticians, Solution Providers.

• **Concerns:** competencies and skills forecast.

• **Definition:** defines the underlying current and expected supporting competencies and skills of organizational resources.

• **Recommended Implementation:** timeline, tabular format, SysML Block Definition Diagram.
PR-RMC PERSONNEL ROADMAP FORECAST SPECIFICATION
### [Architectural Description] Typical [Competency Forecast]

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<tr>
<th>Category Type</th>
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<th>SARPhase 1</th>
<th>SARPhase 2</th>
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Pr-Tr Personnel Traceability Specification

- **Stakeholders:** Systems Engineers, Enterprise Architects, Solution Providers, Business Architects.
- **Concerns:** traceability between operational activities and functions that implements them.
- **Definition:** depicts the mapping of functions (performed by organizational resources) to operational activities and thus identifies the transformation of an operational need into a purposeful function performed by an organizational resource or solution.
PR-TR PERSONNEL TRACEABILITY SPECIFICATION

```
«stereotype»
OperationalActivity
[Activity]

«stereotyped relationship»
{stereotype = Implements}

«stereotype»
Function
[Activity]

«stereotyped relationship»
{stereotype = Implements}

«stereotype»
ServiceFunction
[Activity]
```
**Definition**

Several functions and operational activities are interconnected in the system view. The `Recover Victim` function is implemented by the `SafePlace` operational performer. The `Process Warning Order` function implements the `Rescue` and `Search` operational activities, performed by the `Maritime Rescue Unit v1` capability configuration. The `Rescue Victim` function is associated with the `Move` and `Transport` functions.

- **Recover Victim**: Implemented by `SafePlace`.
- **Process Warning Order**: Implements `Rescue` and `Search` activities.
- **Rescue Victim**: Implements `Rescue` activity.
- **Apply First Aid**: Implements `Rescue` and `Search` activities.
- **Determine Destination**: Implements `Process Warning Order` activity.
[Architectural Description] System View (Implementation Matrix)

Implemented By

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Report
CONCLUSIONS

• The UAF defines enterprise architectures
  – At various levels of abstraction
  – From multiple viewpoints

• The UAF implements DoDAF, NAF and MODAF in SysML
  – Traces to systems engineering
  – Provides multiple forms of trade-off analysis

• Human Factors have been integrated into the UAF as a set of personnel views

• This will enable systems that are fit for humans
Thanks for your attention!